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# Disentangling the role of social cognition processes at early steps of alcohol abuse: the influence of affective theory of mind

Séverine Lannoy [a,b], Fanny Gilles [a], Farid Benzerouk [a,c], Audrey Henry [a,c], Ali Oker [a], Delphine Raucher-Chéné [a,c], Chrystel Besche-Richard [a], & Fabien Gierski [a,c,d]

[a] *Cognition Health and Society Laboratory (EA 6291), Université de Reims Champagne-Ardenne, 57 rue Pierre Taittinger - 51571 Reims, France.*

[b] *Laboratory for Experimental Psychopathology (LEP), Psychological Science Research Institute, Université catholique de Louvain, 10 Place Cardinal Mercier, Louvain-la-Neuve, Belgium.*

[c] *Pôle Universitaire de Psychiatrie, EPSM Marne, 8 Rue Roger Aubry, Reims, France.*

[d] *INSERM U1247 GRAP, Research Group on Alcohol and Drugs, Université de Picardie Jules Verne, Chemin du Thil, Amiens, France.*

Email addresses: severine.lannoy.phd@gmail.com, gilles.fanny@gmail.com, benzeroukf@epsm-marne.fr, audrey.henry@univ-reims.fr, ali.oker@univ-reims.fr, delphine.raucher-chene@mail.mcgill.ca, chrystel.besche@univ-reims.fr, fabien.gierski@univ-reims.fr.

Corresponding author: Séverine Lannoy, PhD, Laboratoire C2S (EA6291)
Université de Reims Champagne-Ardenne, Maison de la Recherche
57, rue Pierre Taittinger - 51096 Reims Cedex - France



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Email: severine.lannoy.phd@gmail.com

**Abstract**

Excessive alcohol use among adolescents has become a pressing challenge among Western societies. Accordingly, one of the current research objectives is to identify the processes associated with this harmful habit. Although numerous studies have underlined the role of executive and motivational processes, few have explored emotional and interpersonal abilities at early steps of alcohol abuse. The present study evaluated the role of two social cognition processes, namely theory of mind (ability to infer others' mental states at cognitive and affective levels) and empathy (ability to understand others' feelings at cognitive and affective levels) in adolescents' alcohol consumption. Two hundred and two adolescents (13-20 years old) performed a behavioral task evaluating theory of mind and filled in questionnaires measuring personal data, empathy, alcohol consumption (alcohol abuse and specific binge drinking), as well as depressive and anxiety symptoms. Findings showed that cognitive and affective empathy were negatively associated with alcohol consumption in youth whereas affective theory of mind was related to specific binge drinking. Importantly, affective theory of mind predicted binge drinking in adolescents, even after controlling for age, gender, and education level. These results emphasized the role of social cognition in early alcohol abuse and showed that, beyond inhibition, interpersonal abilities might precipitate excessive drinking in youth.

*Keywords*: Binge drinking; AUDIT-C; Theory of Mind; Empathy; Affective

## 1. Introduction

Alcohol-related disorders are considered a major public health concern (Rehm et al., 2009), related to consequences at physical (Nutt, King, & Phillips, 2010), cognitive (Stavro, Pelletier, & Potvin, 2013), and cerebral (Bühler & Mann, 2011) levels. Numerous studies have then been conducted to improve the understanding of these disorders and propose prevention and intervention programs. In the two last decades, new research topics have emerged about excessive alcohol use in young people and suggested that this issue may lead to a better conceptualization of alcohol use disorders (e.g., Knight et al., 2002). In particular, binge drinking is a widespread alcohol consumption pattern in youth (ESPAD, 2016; Kanny, Liu, Brewer, & Lu, 2013), characterized by important alcohol intakes and rapid intoxications together with abstinence periods (Courtney & Polich, 2009). It has been proposed (e.g., Stephens & Duka, 2008) that binge drinking shares some common features with severe alcohol use disorders (i.e. brain alterations, cognitive and affective impairments). Nowadays, several studies have been conducted among young people presenting binge drinking habits and results globally confirm that binge drinking is related to cognitive deficits (memory and executive functions; see Carbia, López-Caneda, Corral, & Cadaveira, 2018 for a systematic review) and cerebral alterations (see Hermens et al., 2013; Maurage et al., 2013a for reviews). More recently, studies have also shown that binge drinkers exhibit difficulties to recognize and categorize emotions (e.g., Lannoy et al., 2018a). Current results thus clearly identify binge drinking as a hazardous behavior related to various impairments. However, alongside these findings, there is still a critical issue concerning the factors that predict excessive alcohol consumption in young people.

Numerous studies have been interested in the factors predicting binge drinking habits in adolescence. On the one hand, epidemiological studies have underlined the importance to consider age and gender in binge drinking research. Indeed, an elevated binge drinking prevalence has been observed among men in most countries and was strongly and positively related to age (World Health Organization, 2014). In Europe, gender differences were supported among adolescents, with an increased prevalence in men in half of the countries (e.g., France; ESPAD, 2016). On the other hand, psychological studies have indicated impulsivity as an important process to understand binge drinking in youth, particularly positive and negative urgency (Tomko, Prisciandaro, Falls, & Magid, 2016), namely the tendency to act rashly face to intense emotions. This result has been supported thanks to behavioral measures, showing that the difficulty to inhibit prepotent response predicts the initiation of the first alcohol drink while working memory impairments predict the first binge drinking episode in adolescents who did not drink alcohol two years before (Peeters et al., 2015). Beyond impulsivity, processes related to affective tendencies towards alcohol have also been identified (e.g., implicit attitude; Thush & Wiers, 2007). Among these processes, drinking motives appear as strong predictors of binge drinking in adolescence (in particular coping; Laghi et al., 2016; and enhancement; Lannoy, Dormal, Billieux, & Maurage, 2019). These results thus bring important insights but it is disappointing to realize that few studies investigate the predictive role of emotional and interpersonal processes in binge drinking. Indeed, these processes have been recognized as important for the understanding of adolescents' substance use (Fluharty, Heron, & Munafò, 2018) and are clearly considered as critical risk factors in severe alcohol use disorders (e.g., Uekermann & Daum, 2008).

Actually, research targeting severe alcohol use disorders emphasizes that, beyond memory and executive functions, patients also exhibit deficits for social cognition processes, particularly emotion recognition, theory of mind (ToM) (see Bora & Zorlu, 2017 for a meta-analysis), and empathy (see Massey, Newmark, & Wakschlag, 2018 for a review); these processes being identified as robust predictors of relapse (Rupp, Derntl, Osthaus, Kemmler, & Fleischhacker, 2017; Uekermann & Daum, 2008). Social cognition is based on the ability to build representations from the relationships with others (Adolphs, 2001) and encompasses processes aiming to manage social behaviors (e.g., emotion recognition, ToM, empathy). ToM is defined as the ability to infer knowledges, needs, intentions, beliefs, and feelings from others at first (understand someone) and second (understand what someone believes about what someone else thinks) orders (Shamay-Tsoory & Aharon-Peretz, 2007). Scholars have also proposed a distinction between cognitive (i.e. infer others' knowledges, needs, intentions, and beliefs) and affective (i.e. infer others' feelings and emotions) traits in ToM. Empathy is the ability to understand the feelings of others and to share emotions (Shamay-Tsoory, 2011). Empathy has also been divided into two components, cognitive (i.e. refer to the cognitive understanding of others' emotions) and affective (i.e. refer to emotional feeling and sharing) empathy (Reniers, Corcoran, Drake, Shryane, & Völlm, 2011).

In youth, few studies have investigated the relationship between excessive alcohol use and social cognition. The current literature shows brain alterations in association with the processing of emotional cues in binge drinking, particularly reduced electrophysiological activity during the processing of negative emotional images (Connell, Patton, & McKillop, 2015; Huang, Holcomb, Cruz, & Marinkovic,

2018) and increased, potentially compensatory, brain activity during the decoding of emotional faces and voices (Lannoy et al., 2018b; Maurage, Bestelmeyer, Rouger, Charest, & Belin, 2013). Moreover, at the behavioral level, a global difficulty to recognize facial emotional expressions was observed in binge drinkers (Lannoy et al., 2018a). It has also been shown that this difficulty to recognize emotions predicted binge drinking in young adults (Lannoy et al., 2018a). Besides, emotional states, such as depressive or anxiety symptoms, has been related to binge drinking (Kachadourian, Pilver, & Potenza, 2014; Mushquash et al., 2013). These results are in line with previous findings, showing the importance of drinking motives to deal with negative emotions (Laghi et al., 2016) and poor emotion regulation in youth's alcohol consumption (Laghi, Liga, & Pompili, 2018; Laghi, Bianchi, Lonigro, Pompili, & Baiocco, 2019). These results thus underline that impairments in emotional and interpersonal processes are already observed at early steps of alcohol abuse and reinforce the need to explore the role of social cognition. Actually, recent studies have investigated the role of social cognition processes, especially empathy and ToM in adolescents binge drinking. First, no direct associations were observed between ToM and binge drinking but it appeared that conformity motives (i.e. drinking alcohol to avoid the negative judgment of others) moderated the relationship between ToM and binge drinking (Laghi, Bianchi, Pompili, Lonigro, & Baiocco, 2019a). Second, it has been shown that poor affective empathy predicted binge drinking (Laghi, Bianchi, Pompili, Lonigro, & Baiocco, 2019b). Nevertheless, it remains unclear to what extent both ToM and empathy may directly and specifically predict binge drinking in youth.

The current study explores the conjoint role of two social cognition processes, ToM and empathy, in alcohol use among adolescents. In particular, the specific role

of these processes in binge drinking was assessed by performing separate analyses to predict alcohol abuse on the one hand and specific binge drinking pattern on the other hand. In view of previous findings (ESPAD, 2016; Mushquash et al., 2013), these analyses were controlled for age, gender, depressive and anxiety symptoms when statistically appropriated. According to earlier literature (e.g., Maurage et al., 2016), showing that severe alcohol use disorders were associated with a specific difficulty to detect emotional cues and correctly understand/infer other people's feelings and intention, with a preserved ability to use cognitive cues to understand/infer these states, we hypothesize a dissociation between the cognitive and affective components of these processes in adolescents' drinkers: affective ToM and empathy would be related to alcohol consumption while cognitive ToM and empathy would not.

## 2. Materials and Methods

### *2.1. Participants and Procedure*

Two hundred and twenty-four adolescents were recruited from French secondary schools to participate in an online survey (provided using LimeSurvey®) evaluating alcohol consumption. All the participants were native French speakers. They performed a behavioral task evaluating ToM and filled in questionnaires assessing age, gender, education level (number of years), empathy, alcohol consumption, as well as anxiety and depressive symptoms. The study was approved by the ethics committee of the University and conducted according to the Declaration of Helsinki and its subsequent amendments. Personal consents were obtained for all the participants. They were reminded that they had no obligation to participate and

that they were to engage only with the consent of their parents or legal guardians. Finally, it was stated that they could interrupt their participation at any time without any consequences or need for justification. No identifying data, such as name, IP Address, e-mail or date of birth were collected to ensure their anonymity.

## ***2.2. Measures***

### *2.2.1. Theory of Mind*

ToM was evaluated thanks to the Yoni's task (Shamay-Tsoory & Aharon-Peretz, 2007), which considered cognitive and affective ToM. This task measured the ability to infer mental states based on eye gaze cues, it included 55 trials in which the outline face of a character (named Yoni) was presented together with either (1) four colored pictures (first-order part; e.g., an animal) or (2) four faces related to four colored pictures (second-order part; e.g., a toy). Stimuli were displayed as follows: Yoni's face at the center of the computer screen and the four pictures/faces at each corner of the screen. In each trial, a sentence appeared on the top screen (e.g., first-order part: "Yoni is thinking of…"; second-order part: "Yoni is thinking about the toy that… wants") and participants had to correctly identify the picture/face to which Yoni is directed to. Two conditions were assessed: cognitive ToM (19 trials) and affective ToM (21 trials). In the cognitive condition, both Yoni's facial expression and the sentence were emotionally neutral (e.g., a neutral face, "Yoni thinks"). In the affective condition, both stimuli referred to emotional information (e.g., a happy face, "Yoni loves"). The 14 other trials presented a "physical condition", constituting a control evaluation in which participants can answer without referring to the eye gaze of the character (i.e. Yoni being positioned near to the object rather than at the center of the

screen). The internal consistency of this task has been evaluated by reliability coefficients (correlations between experimental blocks; Rosenthal & Rosnow, 1991) and supported in the current sample (i.e. for first-order part: $r = .32$, $p < .001$ and second-order part: $r = .63$, $p < .001$). Accuracy score (percentage of correct responses) was recorded as the main dependent variable.

### *2.2.2. Empathy*

Empathy was evaluated by the Basic Empathy Scale (D'Ambrosio et al., 2009; Jolliffe and Farrington, 2006), a self-reported questionnaire developed among adolescents to assess cognitive and affective empathy. The scale included 20 items, 9 evaluating cognitive empathy (e.g., "I can understand my friend's happiness when s/he does well at something") and 11 evaluating affective empathy (e.g., "My friend's emotions don't affect me much"). Answers were given on a 5-point Likert scale ranging from 1 ''strongly disagree" to 5 ''strongly agree". Higher scores reflect elevated levels of empathy. The reliability of this questionnaire has been supported in the current sample for the affective subscale (Cronbach's $\alpha = .77$). However, the cognitive subscale had a poor internal consistency ($\alpha = .39$).

### *2.2.3. Alcohol consumption*

Alcohol consumption was assessed by two validated tools aiming to qualify excessive alcohol use: (1) the Alcohol Use Disorders Identification Test-Consumption (AUDIT-C; Bush et al., 1998), measuring alcohol consumption frequency, intensity, and the number of drinking episodes in which participants drank more than six alcohol units in one occasion. The AUDIT-C has been found as reliable to capture alcohol abuse and alcohol use problems among adolescents (Liskola et al., 2018); (2) the binge drinking score (BD score), based on three specific items evaluating

binge drinking habits, namely the consumption speed (i.e. number of alcohol units consumed per hour), the frequency of drunkenness episodes, and the percentage of drunkenness episodes compared to the total number of drinking occasions in the last six months. These items were computed as follows: [(4*consumption speed) + drunkenness frequency + (0.2*drunkenness percentage)]. The BD score has been proposed in addition to the AUDIT-C, as it reflects drinking pattern rather than alcohol consumption (Townshend & Duka, 2002). The usefulness and validity of this score have been supported in numerous studies (e.g., Bø, Aker, Billieux, & Landrø, 2016; Laghi et al., 2016).

#### *2.2.4. Depressive and anxiety symptoms*

Mood-related symptoms were controlled for by using the Beck Depression Inventory (BDI-short form; Reynolds & Gould, 1981), a 13-item self-reported questionnaire assessing the intensity of depressive symptoms based on a Likert scale (from 0 to 3), and the Trait Anxiety Inventory (STAI; Spielberger, Gorsuch, Lushene, Vagg, Jacobs, 1983), a 20-item self-reported questionnaire assessing various anxiety symptoms (Likert scale from 1 “no” to 4 “yes”). The reliability of these questionnaires has been supported in the current sample by very good Cronbach’s alphas (α = .87 for the BDI-short and α=.89 for the STAI).

### ***2.3. Data reduction***

Before computing statistical analyses, the current data have been carefully checked to exclude outliers (i.e. more than three standard deviations): two participants with extreme/aberrant BD scores, one participant with lower cognitive empathy score and four with extreme ones. No aberrant data were recorded for

affective empathy. Regarding ToM, we proceeded in accordance with previous studies (Shamay-Tsoory & Aharon-Peretz, 2007) and excluded nine individuals presenting scores lower than 50% at the control physical conditions. The final sample was therefore composed of 202 adolescents (62.4% of girls), between 13 and 20 years old (*M*=16.77; *SD*=1.31).

### *2.4. Statistical Analyses*

Analyses were conducted with IBM SPSS Statistics 25®. The relationships between alcohol consumption (alcohol abuse, binge drinking) and social cognition (ToM, empathy) were explored through correlational analyses. In the same vein, correlations were performed between alcohol consumption and all variables of interest such as age, gender (1=boy; 2=girls), education level, depressive symptoms, and trait anxiety. The variables significantly related to alcohol consumption in this second analysis were added as control variables in the following analyses. Indeed, to test our main hypothesis, two hierarchical linear models were computed to predict alcohol consumption (i.e. alcohol abuse, as reflected by the AUDIT-C score and specific binge drinking, as reflected by the BD score) from social cognition processes (cognitive and affective ToM, cognitive and affective empathy). The absence of multicollinearity between the predictors was supported by the Variance Inflation Factors, all values were below 3.63 (Allison, 1999). The significance level was set at $p < .05$.

## 3. Results

The description of the sample was reported in *Table 1*.

**Table 1**. Characteristics of the sample and performance in Yoni's task (*N* = 202).

| | Mean (SD) | Range |
|---|---|---|
| Age | 16.77 (1.31) | 13 – 20 |
| Education level (years) | 11.37 (1.19) | 7 – 14 |
| AUDIT-C score | 4.00 (2.60) | 0 – 12 |
| Binge drinking score | 20.27 (16.49) | 0 – 84 |
| Consumption speed (drinks/hour) | 2.37 (1.65) | 0 – 7 |
| Drunkenness episodes (number/6 months) | 4.34 (8.20) | 0 – 60 |
| Percentage of drunkenness (%; 6 months) | 31.19 (31.14) | 0 – 100 |
| BDI score | 8.98 (6.83) | 1 – 39 |
| STAI-Trait score | 48.62 (10.57) | 22 – 70 |
| BES Cognitive empathy score | 34.84 (3.13) | 25 – 42 |
| BES Affective empathy score | 40.14 (6.42) | 20 – 54 |
| Yoni Physical condition (total score; %) | 93.32 (10.77) | 50 – 100 |
| Yoni Cognitive ToM 1st order (%) | 99.08 (3.79) | 71.43 – 100 |
| Yoni Affective ToM, 1st order (%) | 99.17 (3.31) | 77.78 – 100 |
| Yoni Cognitive ToM 2nd order (%) | 77.27 (18.42) | 25.00 – 100 |
| Yoni Affective ToM 2nd order (%) | 82.18 (17.99) | 16.67 – 100 |

*Note.* AUDIT = Alcohol Use Disorders Inventory Test; BDI = Beck Depression Inventory; STAI = State-Trait Anxiety Inventory; BES = Basic Empathy Scale; ToM = Theory of Mind.

### *3.1. Correlational Analyses*

All correlations were reported in *Table 2*. Regarding the main variables of interest, results showed that alcohol consumption was significantly and negatively related to both cognitive (AUDIT-C score: $r = -.14$, $p = .042$; BD score: $r = -.19$, $p = .006$) and affective (AUDIT-C score: $r = -.22$, $p = .002$; BD score: $r = -.14$, $p = .047$) empathy and that binge drinking was also negatively associated with second-order affective ToM (BD score: $r = -.16$, $p = .026$).

**Table 2**. Correlations between alcohol consumption (AUDIT-C and BD scores) and age, gender, depression and anxiety symptoms, empathy, theory of mind ($N$ = 202).

| **Variable** | 1. | 2. | 3. | 4. | 5. | 6. | 7. | 8. | 9. | 10. | 11. | 12. |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| 1. Age | - | - | - | - | - | - | - | - | - | - | - | - |
| 2. Gender | -.07 | - | - | - | - | - | - | - | - | - | - | - |
| 3. Education level | .84** | -.06 | - | - | - | - | - | - | - | - | - | - |
| 4. Binge drinking score | .36** | -.22* | .31** | - | - | - | - | - | - | - | - | - |
| 5. AUDIT-C score | .39** | -.29** | .26** | .74** | - | - | - | - | - | - | - | - |
| 6. BDI | -.15* | .19* | -.10 | .02 | -.06 | - | - | - | - | - | - | - |
| 7. STAI-Trait | -.15* | .19* | -.08 | .05 | .02 | .73** | - | - | - | - | - | - |
| 8. BES Cognitive empathy | -.21** | .03 | -.23** | -.19* | -.14* | -.09 | -.07 | - | - | - | - | - |
| 9. BES Affective empathy | -.18* | .39** | -.13 | -.14* | -.22** | .07 | .19** | .26** | - | - | - | - |
| 10. Yoni Cognitive ToM 1st order | -.10 | -.08 | -.07 | .05 | .08 | -.02 | .03 | -.04 | -.01 | - | - | - |
| 11. Yoni Affective ToM 1st order | -.15* | -.13 | -.08 | .03 | -.02 | -.03 | .06 | .07 | .03 | .32** | - | - |
| 12. Yoni Cognitive ToM 2nd order | .03 | -.14 | -.03 | -.04 | .04 | -.12 | -.06 | .09 | .09 | -.03 | -.01 | - |
| 13. Yoni Affective ToM 2nd order | .05 | .01 | .02 | -.16* | -.10 | -.13 | -.05 | .08 | .12 | .04 | .04 | .63** |

*Note.* BDI = Beck Depression Inventory; STAI = State-Trait Anxiety Inventory; BES = Basic Empathy Scale; ToM = Theory of Mind; * = p<.05; ** = p<.01.

### *3.2. Regression*

The regression models were presented in *Table 3* and accounted for 25% (AUDIT-C score) and 18% (BD score) of the variance. In view of the results found in correlational analyses, age, gender, and education level were first introduced in the regression model (Step 1), followed by social cognition processes (cognitive and affective ToM, cognitive and affective empathy; Step 2). In the first step, age and gender were identified as significant predictors in both models but in the prediction of AUDIT-C score, education level was also found as a significant factor. In the second step, after controlling for these variables, second-order affective ToM was identified as a significant predictor of alcohol abuse (AUDIT-C score: B = -.19, p = .020) and specific binge drinking (BD score: B = -.22, p = .009) in adolescents. However, whereas the adding of social cognition processes, particularly affective ToM, significantly increased the explanatory variance to predict binge drinking, it failed to enhance the prediction model of alcohol abuse (see Table 3).

**Table 3**. Hierarchical multiple regression analyses predicting alcohol abuse (AUDIT-C score; first part) and specific binge drinking (BD score; second part).

| | | | | | | | |
|---|---|---|---|---|---|---|---|
| | | ***AUDIT-C score*** | | | | | |
| | *Predictors* | *Bêta* | *B* | *SE* | *P value* | *Adj. $R^2$* | *$\Delta R^2$* |
| 1 | Age | .57 | 1.13 | .23 | <.001 | .231 | .242*** |
| | Gender | -.27 | -1.44 | .33 | <.001 | | |
| | Education level | -.23 | -.52 | .25 | .041 | | |
| 2 | | | | | | .246 | .037 |
| | Age | .58 | 1.15 | .23 | <.001 | | |
| | Gender | -.23 | -1.25 | .37 | .001 | | |
| | Education level | -.24 | -.52 | .25 | .040 | | |
| | BES Cognitive empathy | -.05 | -.04 | .05 | .423 | | |
| | BES Affective empathy | -.03 | -.01 | .03 | .662 | | |
| | Yoni Cognitive ToM 1st order | .11 | .08 | .05 | .081 | | |
| | Yoni Affective ToM, 1st order | -.01 | -.01 | .05 | .945 | | |
| | Yoni Cognitive ToM 2nd order | .11 | .02 | .01 | .194 | | |
| | Yoni Affective ToM 2nd order | -.19 | -.03 | .01 | .020 | | |
| | | ***BD Score*** | | | | | |
| | *Predictors* | *Bêta* | *B* | *SE* | *P-value* | *Adj. $R^2$* | *$\Delta R^2$* |
| 1 | Age | .34 | 4.26 | 1.51 | .005 | .155 | .168*** |
| | Gender | -.19 | -6.51 | 2.21 | .004 | | |
| | Education level | .01 | .17 | 1.67 | .917 | | |
| 2 | | | | | | .184 | .052* |
| | Age | .38 | 4.72 | 1.53 | .002 | | |
| | Gender | -.18 | -6.24 | 2.44 | .011 | | |
| | Education level | -.02 | -.33 | 1.67 | .844 | | |
| | BES Cognitive empathy | -.12 | -.61 | .36 | .094 | | |
| | BES Affective empathy | .04 | .11 | .19 | .564 | | |
| | Yoni Cognitive ToM 1st order | .06 | .27 | .30 | .368 | | |
| | Yoni Affective ToM, 1st order | .05 | .27 | .34 | .430 | | |
| | Yoni Cognitive ToM 2nd order | .07 | .06 | .08 | .412 | | |
| | Yoni Affective ToM 2nd order | -.22 | -.20 | .08 | .009 | | |

*Note.* BES = Basic Empathy Scale; ToM = Theory of Mind; *N* = 202.

## 4. Discussion

The current literature has mainly identified cognitive and motivational processes as significant predictors of excessive alcohol use in youth. However, recent studies have shown that emotional and interpersonal processes can also be impaired in youth with patterns of binge drinking. The purpose of this study was therefore to explore whether these processes can predict early alcohol abuse in adolescence. In particular, we focused on two social cognition processes, only recently highlighted in youth's alcohol consumption (Laghi et al., 2019a; 2019b), and identified as central in severe alcohol use disorders, namely ToM and empathy. Accordingly, we specifically explore the conjoint and direct role of these processes in alcohol abuse and specific binge drinking pattern.

Findings of the present study underline the importance of age, gender, and education level whereas depressive and anxiety symptoms do not seem related to alcohol consumption in the current sample. The associations with age and education level are consistent with previous studies (e.g., Kuntsche, Kuntsche, Thrul, & Gmel, 2017; Moure-Rodríguez et al., 2016), showing an increased prevalence of excessive alcohol use at the end of adolescence and in early adulthood (20–25 years old) and in populations with high education level. However, the influence of gender in adolescents binge drinking is less pronounced nowadays (e.g., Laghi et al., 2019b)

and appears related to other factors such as the country of origin. Accordingly, by indicating an association between being a men and binge drinking, our results are in line with those previously reported in France (ESPAD, 2016). Regarding the absence of relation with depressive and anxiety symptoms, our results may be understood through the population. Indeed, in contrast with previous studies (e.g., Kachadourian et al., 2013), we do not recruit adolescents with specific predispositions (e.g., trauma) or motives to drink but rather include youth from the community. Accordingly, it can be hypothesized that, in the general population, the association between excessive alcohol use and psychopathological symptoms appears later in the developmental trajectory. In the current study, the role of social cognition has thus been highlighted without the association with depression and anxiety symptoms.

Second, results support the relationships between alcohol consumption, empathy, and ToM. These two processes, widely described in the field of severe alcohol use disorders (Bora & Zorlu, 2017; Massey et al., 2018), are thus identified as significant processes at early steps of excessive alcohol use in adolescents. Especially, it is observed that alcohol abuse is associated with cognitive and affective empathy and predicted by second-order affective ToM. However, the relation with ToM does not appear sufficiently robust to significantly increase the variance of the prediction model when we control for age, gender, and education level. In contrast, binge drinking is related to both empathy scores, second-order affective ToM, and is significantly predicted by this subdimension of affective ToM, even after controlling for personal variables.

Compared to studies conducted among patients (e.g., Maurage et al., 2011) and adolescent binge drinkers (Laghi et al., 2019), these results support a difficulty to feel and answer appropriately to emotions from others but also to cognitively

understand the emotions of others. The current study thus endorses the role of affective empathy and shows the significance of cognitive one, previously found as preserved (Laghi et al., 2019). Actually, our findings are not totally comparable to those of Laghi and colleagues (2019), as we do not use the same measure. Moreover, it has to be noted that, in line with our findings, results in severe alcohol use disorders were recently contrasted by showing cognitive and affective empathy impairments by means of a computerized test of empathy (Grynberg, Maurage, & Nandrino, 2017). The current results might thus be consistent with recent studies. However, it is worth noting that reliability analyses in the current sample underlined a poor internal consistency of the cognitive empathy subscale. Therefore, this result should be confirmed in future studies with self-reported and behavioral measures.

Regarding ToM, these results reinforce previous ones (Laghi et al., 2019a) by showing a dissociation between cognitive and affective ToM and a direct relationship between binge drinking and second-order affective ToM. The current findings are thus in line with those observed in severe alcohol use disorders (Maurage et al., 2016). Importantly, results appear quite stable, as they remain significant to predict binge drinking in a hierarchical regression model after controlling for personal variables. Accordingly, it could be suggested that the relationship with social cognition processes is “pattern-specific”, in line with the proposal that binge drinking is a particular harmful habit (Stephens & Duka, 2008). Nevertheless, this should be supported by other studies comparing binge drinking with general alcohol consumption (as the AUDIT-C used in the current study contains an item referring to the consumption of large alcohol quantities in one occasion). In particular, the current findings show that second-order affective ToM predicts binge drinking whereas first-

order processes do not seem associated with excessive drinking. It therefore appears that only complex ToM abilities are related to binge drinking, as second-order processing requires to correctly understand others' internal states but also to make the difference between the first individual's interpretation and the second individual's intention (Shamay-Tsoory & Aharon-Peretz, 2007). This result is quite consistent with the population, as we recruited adolescents who do not report other psychopathological disorders. However, it could be hypothesized that both first and second-order ToM processes would become impaired in later stages of alcohol-related disorders, notably due to the alcohol effects on the prefrontal cortex (Uekermann & Daum, 2008).

As a whole, the main finding of this paper is that alcohol abuse and specific binge drinking in youth are predicted by age and gender, consistently with previous studies (e.g., Degenhardt et al., 2008), but that binge drinking is also predicted by affective ToM. Beyond cognitive and alcohol-related processes, interpersonal abilities are thus also involved in the emergence of excessive drinking among adolescents. More precisely, besides the ability to feel emotions from others, binge drinking is predicted by a global difficulty to infer the feelings of others. This result reinforces that adolescents with poor interpersonal abilities tend to drink alcohol excessively to be more comfortable in social contexts (Laghi et al., 2019b). Especially, poor abilities to understand what others infer about someone's feelings and emotions might lead to awkward social experience or even social distress and precipitate excessive alcohol use, as a maladaptive coping strategy. This hypothesis is strengthened by previous results, showing the crucial role of coping motives and emotional impulsivity to predict adolescents' binge drinking (Laghi et al., 2016; Tomko et al., 2016) and

supports the high social involvement described in this population (Kuntsche et al., 2014).

This study is among the first exploring the predictive value of ToM and empathy in adolescents with excessive alcohol habits (see also Laghi et al., 2019a; 2019b), findings therefore open new research perspectives. Accordingly, future studies should further explore the role of various social cognition processes (e.g., emotions recognition, ToM, empathy, social perception and knowledge) in general alcohol use and specific binge drinking. This exploration has to be conducted by using validated and reliable self-reported and behavioral measures. Indeed, our results underlined that, despite the selection of validated tools, the questionnaire used to assess empathy exhibited a poor reliability in the current sample (i.e. for the cognitive empathy subscale). This association should thus be further explored. Moreover, to support the genuine predictive role of these processes, subsequent research has to explore this question with longitudinal approaches. Indeed, a limitation of the current research is the cross-sectional nature of the data, hampering strong inferences regarding the cause-effect relationships between social cognition and alcohol consumption. In future studies, the potential role of alcohol use history (e.g., age at first drink, age at first drunkenness episode) have to be took into account. Moreover, the current study exclusively focused on social cognition processes while controlling for anxiety and depression. Subsequent research should also consider the role of social cognition together with other well-identified predictive factors of binge drinking such as impulsivity (Tomko et al., 2016). Nevertheless, the current study also has several implications for the understanding of binge drinking and alcohol use disorders. First, it shows that interpersonal difficulties already play

an important role at primary steps of alcohol-related disorders. Second, it highlights the specific role of emotional and interpersonal processes in excessive drinking in youth, in addition to the existing literature regarding executive functions. It reinforces the need to consider binge drinking as a specific, complex, and harmful behavior, explained by various and potentially interacting processes, and clearly not more as a general and recreational alcohol use pattern. Finally, these findings may help to the building of adapted prevention and intervention programs, not only targeting motivational factors (Wurdak, Wolstein, & Kuntsche, 2016) but also focusing on interpersonal (e.g., skills' improvement to infer the feelings from others) and emotional (e.g., learning of adapted coping strategies in social context) abilities.

## Declarations of interest

None.

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